contacting said population of nucleic acid molecules with a first targeting element, wherein said first targeting element binds specifically to at least one nucleic acid sequence of interest in said population of nucleic acid molecules;

selectively attaching a separation group to said bound targeting element, wherein attachment of said separation group is dependent on the nature of said distinguishing element;

immobilizing said attached separation group to a substrate, thereby forming an immobilized targeting element-separation group complex comprising said at least one nucleic acid sequence of interest; and

removing said immobilized targeting element-separation group complex comprising said at least one nucleic acid sequence of interest from said population of nucleic acid molecules, thereby separating said nucleic acid sequence of interest from said population of nucleic acid molecules.

3. (Amended) The method of claim 1, wherein said targeting element binds to said at least one nucleic acid sequence of interest at a sequence within 20 nucleotides of said distinguishing element.

4. (Amended) The method of claim 1, wherein said targeting element comprises a nucleic acid sequence.

9. (Amended) The method of claim 8, wherein said separation group is attached to said targeting element by extending said oligonucleotide with a polymerase in the presence of said biotinylated nucleotide, thereby forming an extended oligonucleotide primer containing said immobilizable nucleotide.

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10. (Amended) The method of claim 3, wherein said targeting element is an oligonucleotide.

14. (Amended)The method of claim 13, wherein said population of DNA molecules is a population of [genomic DNA molecules or a population of] cDNA molecules.

15. The method of claim 1, wherein said population of nucleic acid molecules is a population of RNA molecules.

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16. (Amended) The method of claim 1, wherein said distinguishing element is a single nucleotide polymorphism.

17. The method of claim 1, wherein said substrate is a particle, bead, magnetic bead, or glass surface.

18. (Amended) The method of claim 1, further comprising

contacting said population of nucleic acid molecules with a second targeting element simultaneously with said first targeting element, wherein said second targeting element binds specifically to a second at least one nucleic acid sequence of interest in said population of nucleic acid molecules;

attaching a second separation group to said second bound targeting element;

immobilizing said attached second separation group to a substrate, thereby forming a second immobilized targeting element-separation group complexcomprising said second at least one nucleic acid sequence of interest; and

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removing said immobilized targeting element-separation group complex comprising said second at least one nucleic acid sequence of interest from said population of nucleic acid molecules, thereby separating said second at least one nucleic acid sequence of interest from said population of nucleic acid molecules.

19. (Amended) A method for separating a nucleic acid of interest from a population of nucleic acid molecules, the method comprising;

(a) providing a population of nucleic acid molecules comprising at least one nucleic acid sequence of interest, wherein said at least one nucleic acid sequence of interest includes a distinguishing element;

(b) contacting said population of nucleic acid molecules with a targeting element attached to a separation group, wherein said population of nucleic acid molecules comprises a targeting element which binds specifically to at least one nucleic acid sequence of interest in said population of nucleic acid molecules;

(c) selectively removing said attached separation group from said bound targeting element, wherein removal of said separation group is dependent on the nature of said distinguishing element;

(d) immobilizing to a substrate separation groups remaining attached to said targeting element, thereby forming an immobilized targeting element-separation group complex; and

(e) removing said immobilized targeting group complex comprising said nucleic acid of interest from nucleic acid sequences not containing the attached separation group,

thereby separating said nucleic acid sequence of interest from said population of nucleic acid molecules.

Add the following new claim:

21. (New) The method of claim 13, wherein said population of DNA molecules is a population of genomic DNA molecules.